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ANALYTICAL STUDY OF ENERGY CONSERVATION AND AUDITING

Aarti Kishor Ajapunje
Department of Electrical Engineering,
G. H. Raisoni College of Engineering, Nagpur, India

Sampada Apte
Department of Computer Science, Dharampeth,
Polytechnic Nagpur Affiliated with R.T.M.N.U,
Nagpur, Maharashtra, India

ABSTRACT

Energy is very rare asset, especially in developing and underdeveloped countries. Cost of energy is gradually increasing day-by-day. With an increase in the population there is a change in the standard of living of people which results into more demand for the resources. In India, no matter how much of energy is generated, still there is a scarcity of supply of energy. So the more energy we save is the energy we produce. This paper presents a detailed study of consumption of electrical power and propositions to reduce the energy consumption and to achieve conservation of energy by applying modern power saving techniques. So possible steps need to be identified and adopted to conserve energy and reduce energy cost. Energy conservation is also crucial and necessary as the nation is energy deficient due to which various issues such as low voltage, load shedding and premature failures of equipments come across.

Key words: Efficiencies, Energy Audit, Energy Conservation, Power Consumption, Payback

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1. INTRODUCTION

Industrial energy efficiency has a crucial role in the transition of the economy towards increased sustainability. In any industry, there are basically four ways for energy costs reduction: implementing energy-efficient technologies, energy carrier conversion, load management and more energy efficient behaviour. Energy audit provides an

important tool in reducing barriers in energy efficiency. Industrial energy efficiency is one of the most important means if reducing the threat of increased global warming as the industry accounts for 80% of world's annual coal consumption, 40% of world's electricity use, 35% of world's natural gas consumption and 10% of world's global oil consumption.

2. LITERATURE REVIEW

The author in [1] claims that energy audit is essential to decrease energy wastages and to reduce electrical billing. The author in [2] states that the efficiency of the controlled lightning design will not only reduce power consumption but also will be an important energy saving component. Here comparison of the power consumption between different lightings has been done and their consumption and payback period has been calculated respectively. In paper [5] the author has designed an energy flow structure to show the energy distribution to find the reasons for energy losses to achieve energy conservation.

3. THEORY

3.1. OBJECTIVES OF ENERGY AUDIT

Energy audit provides a vital information base for overall energy conservation programme covering analysis of energy utilization and evaluation of measures for energy conservation. It aims at:

- Identifying the quality and cost of various energy inputs.
- Accessing present pattern of energy consumption in different cost centres of operation.
- Relating energy inputs and production outputs
- Identifying potential areas of thermal and electrical energy economy.
- Highlighting wastages in major areas.
- Fixing of energy saving potential targets for individual cost centres.
- Implementation of measures for energy conservation and realisation of savings.

4. PROPOSED METHODOLOGY

The study was conducted in 3 stages:

- Stage1: Walk through audit to understand process energy drivers, Measurability and formulation of audit plan.
- Stage2: Detailed Energy audit.
- Stage3:Off-site work for data analysis and report preparation.

Table The following instruments were used for the baseline energy audit study:

Sr. No.	Instrument Name	Specification
1	Demand Analyzer	Suitable for 1Ø,3Ø.156 electrical parameters like voltage, current, frequency, harmonics, active& reactive power, power factor
2	Clamp-on power meter	0-1200 kW 0-600V, AC 0-800V, DC 0-2000A, Current AC/DC

4.1. FIELD VISIT AND MEASUREMENT WORK

Nagpur Distillers Private Limited is a Private Company formed on 21 February 2002. It is classified as Indian Non-Government Company and is registered at Registrar of Companies, Mumbai. Its authorized share capital is Rs. 10,000,000 and its paid up capital is Rs. 5,100,000. It is located at plot no. 2, 3 Teka Naka, Uppalwadi, and Kamptee Road, Nagpur-440026.This Company was established in the year 1981-1982.

Nagpur Distillers Pvt. Ltd. is an entity of Bapuna Group. The Bapuna Group is a business house based out of Central India, with diverse concerns primarily split between Nagpur (Maharashtra) and Gwalior (Madhya Pradesh) Despite of its humble beginnings, the Group today has become one of the largest manufacturers of Grain Neutral Sprit, Extra Neutral Alcohol & Rectified Spirit in Central India. The Group also produces and bottles its own brands of alcoholic beverages, which are today well accepted and strongly entrenched in the market. Apart from its own brands, the Group bottles popular brands for some of the world's largest liquor conglomerates such as Pernod Ricard, United Spirits, Radico Khaitan and Allied Blenders & Distillers.

4.2. PLANT ELECTRICAL ENERGY CONSUMPTION

The energy consumption of the factory was categorised in terms of the equipments and functional area wise. The results were found out after calculations during the factory visits. Data loggers, power analyzers, clamp meters, etc. were used to calculate the industry's electrical energy consumption. The total load of the unit is approximately 140 kW

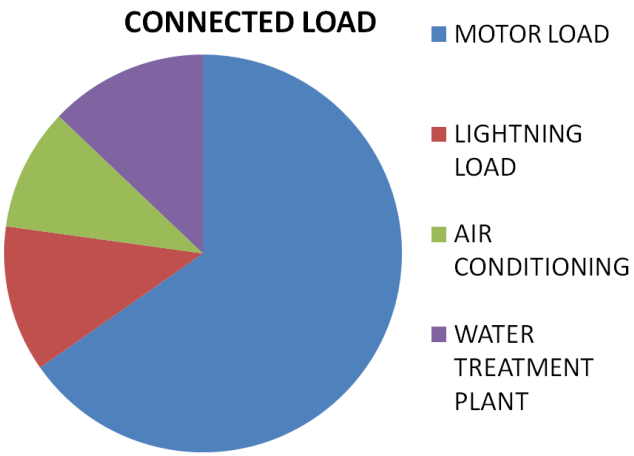

Figure Load Division Chart at NDL

Table Load Division

TYPE OF LOAD	LOAD (kW)	%LOAD
Motor Load	88.774	65.272
Lightning Load	16.201	11.911
Air Conditioning	13.5	9.926
Water Treatment Plant	17.531	12.889

The following points can be observed from this survey:

1. Motor load consumes approximately 65.272 of the total load.
2. The average monthly consumption is 17,000 units.

4.3. LIGHTING SURVEY

A walk-through audit was organised during visits to assess the radiance requirement of the plant and scope for improving the illumination quality and illumination level, with the aim of the reduction of the electrical energy consumption and cost of electricity.

Table Consumption of Individual Devices

DEVICES	POWER(W)	UNITS	TOTAL CONSUMPTION
Tube light	52	101	5252
	40	10	400
	28	34	952
Fans	60	37	2220
Power points	120	24	2880
Industrial Lamps	250	10	2500
Incandescent Lamp	100	4	400
Air Conditioners	1500	9	13500
Computers	340	2	680
Halogens	400	3	1200

4.4. ELECTRICAL ENERGY SYSTEM

Electricity is the main source of energy to meet various energy requirements. The plant requires electricity for different process machines. Lighting, space conditioning, operation of various installed office equipments and in storage units. Electricity is supplied by the distribution company- Maharashtra State Electricity Board (MSEB) through 11kV LT Line. In the case of non-availability of electricity from the distribution company, standby DG set generated electricity powers the plant.

Table Electricity Supply

PARTICULARS	UNIT	DETAILS
Consumer No.	-	419991802119 410012057265
Tariff Category	-	Industrial LT
Meter No.	-	055 _ SPN00512 055 _SPN01192
Type Of Supply	-	3- Phase
Contract Demand	KVA	73
Sanctioned Load	KW	88

In Nagpur Distillers Pvt. Ltd. the annual figures for electricity is shown below:

Table Electricity Annual Fig

Sr. No.	ENERGY SOURCE	UNIT	ANNUAL CONSUMPTION	ANNUAL ENERGY COST IN Rs. (Lakh)
1	Electricity	KWh	181386	16

Month	Total Units Consumed	Power Factor	Load Factor	Billing Demand (kVA)	Demand Charges, Rs.	Energy Charges (Rs.)	PF Incentive/Penalty	Current Month Bill (Rs.)	Rs/KWh
May 2014	19575	0.92	19	65	8450	137217.75	10774.05	164847.03	7.07
June 2014	19617	0.92	19	73	9490	137515.17	11023.2	171247.75	7.07
July 2014	20650	0.92	20	71	9230	144756.5	11565.42	178474.05	7.07
August 2014	14481	0.92	14	71	9230	101511.81	8327.76	129248.1	7.07
September 2014	16370	0.92	16	66	8580	114753.7	9494.76	146743.99	7.07

The current power factor of company is observed to be around 0.922 which was calculated by power analyzer. By this, the company bears a loss of 5000rs every month on power bills by the laws of MSEB. If this power factor is maintained above 0.92 there will no penalties whereas if it is maintained above 0.98 then electricity board (MSEB) grants incentive of about 0.75% of the total monthly bill.

5. RESULT AND ANALYSIS

5.1. HARMONIC STUDY

Harmonic is defined as a component of periodic wave (or a signal) whose frequency is the integral multiple of the fundamental frequency. The presence of harmonics in a network with capacitors causes a current overload on the capacitor itself and results in

increase in temperature and reduces the life of capacitors. Further, the problems that may originate from the presence of harmonics are overload in the PF. Correction capacitor banks, overload of the neutral conductor, additional losses in transformers and in rotating electrical machines, measurement errors in the counters and untimely triggering of safety relays, disturbance and faults in electronic equipments and computers.

Voltage harmonics (% total harmonic distortion) recorded at the transformer is within the limits specified by ANSI Standard IEEE 519 – 1992 which is 5%

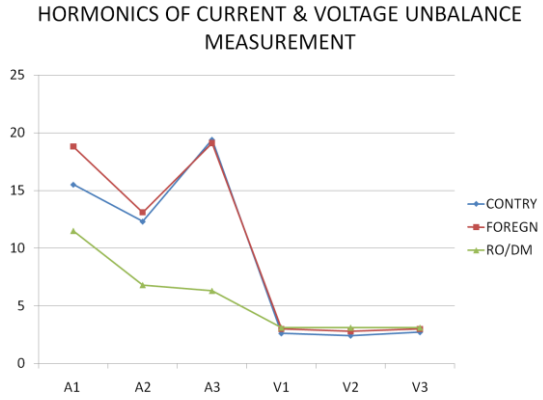

Figure Harmonics of Current & Voltage Unbalance Measurement

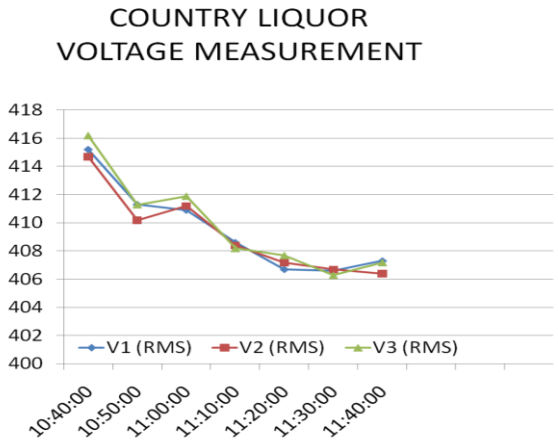

Figure Country Liquor Voltage Measurement

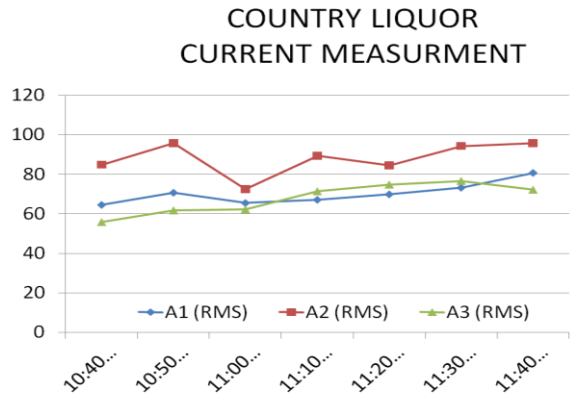

Figure Country Liquor Current Management

5.2. BEST PRACTICES FOR UTILITIES

These are the guidelines the plant should follow in future to increase energy efficiency hence resulting into cut down of energy cost.

Electricity

- Optimize the tariff structure with utility supplier.
- Schedule your operations to maintain high load factor.
- Shut off unnecessary computers, ac's, light etc at night.
- Check utility electric meter with your own meter.
- Correct power factor to at least 0.95 under rated load conditions.

Motors

- Use energy efficient motors where economical.
- Use synchronous motors to improve power factor
- Check alignment.
- Check under-voltage and over-voltage conditions.
- Provide proper ventilation.(for every 10^{o} increase in motor operating temperature over recommended peak, motor life is estimated to be halved.)

Pumps

- Operate pumping near best efficiency point.
- Stop running both pumps-add an auto start for an online spare or add a booster pump in problem area.

Lighting

- Usage of control lighting with the help of clock timers, delay timers, photo cells and /or occupancy sensors.
- Select lamps having high power factor and long term efficiency.
- Install efficient alternatives as given above to possible devices in industry.

5.3. PROPOSED CHANGE OF APPLIANCES

The above table gives an idea of the savings after the replacement of appliances .Also it tells us about the payback time required to recover the investment amount.

The Payback period is calculated as follows:

Payback period = [Investment / Annual Monetary Saving] * 1Year

OR

Payback Period=[Investment / Annual Monetary Saving] *12Months

OR

Payback period = [Investment / Annual Monetary Saving]*365Days

This Company works for about 8hours a day, 260days a year.

Table Payback period of the Appliances

OLD DEVICES	YEARLY CONSUMPTION (Rs)	NEW REPLACEMENT DEVICES	YEARLY CONSUMPTION (Rs)	UNITS SAVED (kW)	PAYBACK TIME (days)
Tube light T12 (52w)	15683.2	Tube light T8 (22w)	7047.04	8636	919
Fans (60w)	32646.43	Super fans (14w)	25029	3540.6	1887
Incandescent Bulbs(100w)	5882.24	CFLs (30w)	1764.672	582.4	134.7
Industrial Lamp (250w)	36764	CFLs (100w)	14705.6	3120	165
Air Conditioner (1500w)	198526	4star- rating Air Conditioner (1088w)	143997.23	7712.64	1988

6. CONCLUSION

In this paper, analytical energy conservation has been done to reduce the energy consumption in the Nagpur Distillers Pvt. Ltd. It highlights the amount of savings that can be obtained with changes in the lightning sector of the industry, so that energy crisis can be decreased to an extent.

The following can be deduced after the completion of the energy audit:

Total energy units saved annually: 22,590 kW

Total amount reduced after the replacement of the devices: Rs 96,959

Payback period of different appliances as given above.

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